

Appl. No. : 09/801,542  
Filed : March 7, 2001

## REMARKS

In response to the Final Office Action mailed June 27, 2003, Applicant respectfully requests the Examiner to reconsider the above-captioned application in view of the above amendments and the following comments.

### Brief Description of the Preferred Embodiments

As mentioned in the Background of the application, in the art of atomic layer deposition, the temperature of the substrate is not considered to be very critical because the growth rate of the film is not dependent on the temperature of the substrate but rather on the sequential exposure to the different reactant pulses. Accordingly, the temperature of the wall of the reactor is not considered to be an important parameter for ALD. Traditionally, the prior art focused on a single "ALD window", which exists above the precursor condensation limit and below the precursor thermal decomposition temperature. As such, both hot wall and cold wall designs have been used in ALD reactors.

With reference to the Specification and Figures 1-3, the traditional ALD temperature window in which self-limited deposition will occur is designated by "W." Applicants realized that within this window there are temperature regions in which decreased OR increased growth per cycle may occur depending upon the process recipe. The preferred embodiments take advantage of this information from the growth curves to minimize deposition on the reactor walls while at the same time optimizing growth rates on the substrate to provide an improved ALD method and apparatus.

Specifically, as mentioned above, cold wall ALD reactors have been used. However, such reactors may cause increased adsorption on the cold regions of the wall for some process recipes. As shown in Figure 1, L1 denotes a region of increased growth at the low end of the temperature window W for some process recipes. In contrast, L2 denotes a region of decreased growth at the low end of the temperature window for some process recipes. There is no teaching in the cited art to avoid or target these low temperature regions of increased or decreased growth.

In a similar manner, hot wall ALD reactors have been used. However, as shown in Figure 1, H1 denotes a region of increased growth at the high end of the temperature window for some

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process recipes. H2 denotes a region of decreased growth at the high end of the temperature window for other process recipes. Again, there is no teaching in the cited art to avoid or target these regions of increased growth or decreased growth.

In contrast, the preferred embodiments take advantage of the ALD growth curves to minimize deposition on the reactor walls to provide an improved ALD method and apparatus. In contrast, the art cited by the Examiner does not disclose any understanding of the regions of increased and decreased growth within the ALD temperature window.

**Claim rejections**

Claims 35, 37, 38, 43-45 and 50-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over of Kim et al. in view of Suntola et al. and Yokoyama et al. Claims 46 and 47 are rejected over the combination of Kim, Suntola and Yokoyama and in further view of Tseng. Claim 57 is rejected over the combination Kim, Suntola, Yokoyama, and Tseng in further view of Lopatin et al. Claims 35, 39-41, 43, 44, 48, and 50-56 are rejected over the combination of Kim and Eichman. Claim 42 is rejected over the combination of Kim and Eichman in further view of Kukli et al. Applicant respectfully traverses the grounds for rejection.

In rejecting these claims, the Examiner relies on Suntola and Eichman for the teaching that “the temperature on the chamber walls should be selected ‘to maintain a lower rate of film growth upon the chamber walls as compared to the substrate’”. However, Suntola (U.S. Patent No. 6,015,590) merely discloses a hot wall reactor in which an atom or molecule may become re-vaporized. As mentioned above, such hot wall ALD reactors were known in the art. However, there is no teaching or suggestion in Suntola to avoid the region of increased growth at the high end of the ALD temperature window for some recipes or to target the region of increased growth for other recipes. In either region, atoms or molecules will still become re-vaporized after a monolayer of ALD deposition is formed. That is, the Examiner assumes that the desire for re-vaporization means that the temperature is in the region H2 (see Figure 1). However, re-vaporization can take place any where within the ALD window W and Suntola simply does not a specify region within the ALD window W.

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In a similar manner, Eichman 5,348,587 merely discloses a cold wall CVD reactor. Again, there is no teaching or suggestion in Eichman to avoid the region of increased ALD growth or to target a region of decreased ALD growth.

The Examiner states that one of skill in the art "would have readily recognized that, in a vapor deposition process, the walls of a reaction chamber should be maintained at a temperature which is sufficiently high to prevent condensation thereon, yet not so high that decomposition of the reactant(s) will occur." Without accepting or disputing this characterization of the prior art Applicants submits that this merely asserts keeping the walls within the ALD window. Applicants' claims are directed to a more specific temperature window and the Examiner has not identified any teaching or suggestion for targeting or avoiding regions of decreased or increased ALD growth within the ALD temperature window.

As such, Applicant respectfully submit that the rejections of Claims 35, 39-44, 48, and 50-57 are in error. Nevertheless, to advance prosecution, Applicant has amended independent Claims 35, 44 and 50. Specifically, Claims 35 and 44 now recite, in part, a method wherein "the second temperature is selected to maintain a lower rate of atomic layer deposition (ALD) film growth upon the chamber walls as compared to the substrate." Claim 50 now recites, in part, a method in which "a rate of deposition by self-limited atomic layer deposition on the substrate is maximized while self-limited atomic layer deposition (ALD) film growth on the walls is reduced relative to controlling a temperature of the substrate alone."

#### CONCLUSION

For the foregoing reasons, it is respectfully submitted that the rejections set forth in the outstanding Office Action are inapplicable to the present claims and specification. Accordingly, early issuance of a Notice of Allowance is most earnestly solicited.

The undersigned has made a good faith effort to respond to all of the rejections in the case and to place the claims in condition for immediate allowance. Nevertheless, if any undeveloped issues remain or if any issues require clarification, the Examiner is respectfully requested to call Applicant's attorney in order to resolve such issue promptly.

Respectfully submitted,

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